PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Jung-Wook Kim, et al.	Examiner: Michail Kornakov
Serial No:	10/606,512	Group Art Unit: 1746
Filed:	June 26, 2003	Docket: 8054-23 (AW8037US/JJ)
For:	**METHOD FOR CLEANING A PROCESSING CHAMBER AND METHOD FOR MANUFACTURING A SEMICONDUCTOR DEVICE**	

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
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AMENDMENT

Sir:

In response to the Office Action dated September 27, 2006, please amend the above-referenced patent application as set forth herein.

IN THE CLAIMS:

Please **amend** the claims as follows:

1. (Currently amended) A method for cleaning a processing chamber comprising:

removing impurities on a semiconductor substrate in the processing chamber with a plasma of a first gas including a hydrogen gas;

removing the semiconductor substrate from the processing chamber; and

~~treating the processing chamber to be substantially free of hydrogen by~~ etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.

2. (Currently amended) The method of claim 1, wherein ~~an inside of the processing chamber includes~~ silicon oxide is removed from the semiconductor substrate in the processing chamber.

3. (Original) The method of claim 1, wherein the first gas includes the second gas.

4. (Original) The method of claim 3, wherein the second gas includes an argon gas.

5. (Original) The method of claim 4, wherein a flow rate ratio between the argon gas and the hydrogen gas in the first gas is about 1:0.8 to about 1:1.2.

6. (Original) The method of claim 1, wherein the impurities on the semiconductor substrate are removed at a temperature of about 450°C to about 550°C.

7. (currently amended) A method for cleaning a processing chamber comprising:

positioning a semiconductor substrate on a stage in the processing chamber;

vacuumizing the processing chamber;

introducing a first gas into the processing chamber wherein the first gas includes an argon gas and a hydrogen gas;

removing impurities on the semiconductor substrate with a plasma of the first gas;

exhausting a gas from the processing chamber;

removing the semiconductor substrate from the processing chamber;

creating a vacuum in the processing chamber;

introducing a non-hydrogenous second gas into the processing chamber; and

etching the processing chamber with a plasma of the second gas to remove ~~prevent~~ hydrogen from ~~radicals or chemical compounds having hydrogen from forming or remaining in~~ the processing chamber.

8. (Original) The method of claim 7, further comprising a belljar is disposed over the stage, and a processing space provided by the belljar and the stage for positioning the semiconductor substrate.

9. (Currently amended) The method of claim 8, wherein at least one of the stage and the belljar ~~includes~~ is comprised of silicon oxide.

10. (Original) The method of claim 7, wherein the impurities on the semiconductor substrate are removed at a temperature of about 450°C to about 550°C.

11. (Original) The method of claim 7, wherein the second gas includes an argon gas.

12. (Original) The method of claim 11, wherein a flow rate ratio between the argon gas and the hydrogen gas in the first gas is about 1:0.8 to about 1:1.2.

13. (Original) The method of claim 7, further comprising exhausting the second gas from the processing chamber after the etching of the processing chamber with the plasma of the second gas is completed.

14. (Original) The method of claim 7, wherein exhausting the gas from the processing chamber includes exhausting the first gas and other compounds generated during the removing of impurities on the semiconductor substrate that have been prevented from depositing on the processing chamber or the substrate.

15. (Currently amended) A method for manufacturing a semiconductor device comprising:

positioning a semiconductor substrate in a processing chamber;

removing impurities on the semiconductor substrate in the processing chamber with a plasma of a first gas including a hydrogen gas;

removing the semiconductor substrate from the processing chamber; and

~~treating the processing chamber to be substantially free of hydrogen by~~ etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.

16. (Original) The method of claim 15, wherein the first gas includes the second gas and the hydrogen gas.

17. (Original) The method of claim 16, wherein the second gas includes an argon gas.

18. (Original) The method of claim 17, wherein a flow rate ratio between the argon gas and the hydrogen gas in the first gas is about 1:0.8 to about 1:1.2.

19. (Original) The method of claim 15, wherein the impurities on the semiconductor substrate are removed at a temperature of about 450°C to about 550°C.

REMARKS

Reconsideration of the application, as amended, is respectfully requested.

I. STATUS OF THE CLAIMS

Claims 1-19 are currently pending. Claims 1, 2, 7, 9 and 15 have been amended herewith to more particularly point out and distinctly claim that which Applicants regard as their invention. In particular, claims 1, 7 and 15 have been amended to further clarify that the processing chamber is etched with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.

Support for the above amendments may be found throughout the specification as originally filed. In particular, support for the above amendments to claims 1, 7, and 15 can be found on page 9, lines 18-20 of the present specification. Moreover, support for the amendment for claim 2 can be found on page 16, lines 12-14 of the present specification to claim 9 can be found on page 17, lines 22-23 of the present specification. No new matter has been added by virtue of this amendment.

II. 35 U.S.C. 112, FIRST PARAGRAPH REJECTIONS

Claims 1, 7 and 15 have been rejected under 35 U.S.C. 112, first paragraph as failing to comply with the written description requirement on the grounds that according to the Examiner, the limitations of "treating the processing chamber to be substantially free of hydrogen" and "to prevent hydrogen radicals or chemical compounds having hydrogen from forming...in the processing chamber" while etching the processing chamber as recited in claims 1, 15 and 7, respectively, were not presented in the original specification.

In response, Applicants respectfully disagree with the Examiners position. However, in order to expedite the prosecution of the present application claims 1, 7, and 15 have each now been amended to recite "...etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber." in place of the previously recited

expressions mentioned in the instant Office Action. As mentioned above, there is clearly support for this amendment to claims 1, 7, and 15 on page 9, lines 18-20 of the present specification.

In view of the above actions taken, it is believed that the above rejection to claims 1, 7, and 15 have been overcome and thus withdrawal of these rejections is requested.

III. EXAMINER'S COMMENT

It appears that the Examiner on page 3 of the instant Office Action has interpreted the term " a non-hydrogenous second gas" as recited in the pending claims as requiring a "gas mixture".

Applicants respectfully disagree with the above interpretation by the Examiner. Rather, it is submitted that it would be clear to one skilled in the art reading the present specification and the pending claims themselves that the term "non-hydrogeneous second gas" as recited in these claims is not limited to the second gas being a gaseous mixture.

IV. 35 U.S.C. 112, SECOND PARAGRAPH REJECTIONS

Claims 2 and 9 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. The Examiner alleges that the expression "...an inside of the processing chamber includes silicon oxide" recited in claim 2 and the expression "...at least one of the stage and the belljar includes silicon oxide" recited in claim 9 constitute indefinite subject matter because according to the Examiner it is not clear whether an impurity of silicon oxide is to be removed or a protective coating including silicon oxide is indicated.

In response, claim 2 has been amended herewith to further clarify that "silicon oxide is removed from the semiconductor substrate in the processing chamber."

In addition, claim 9 has been amended to further clarify that "at least one of the stage and the belljar is comprised of silicon oxide." In other words, claim 9 as amended clarifies that at least one of the stage and belljar is made of silicon oxide material.

In view of the above actions taken, it is believed that the above rejection to claims 2 and 9 have been overcome and thus withdrawal of these rejections is respectfully requested.

V. 35 U.S.C. 103(a) REJECTIONS

(i) Claims 1-4, 7-9, 11 and 13-17 have been rejected under 35 U.S.C. 103(a) as being obvious over U.S. Patent No. 6,649,082 to Hayasaka et al. ("the Hayasaka patent") in view of U.S. Patent No. 5,626,775 to Roberts et al. ("the Roberts patent").

(ii) Claims 5, 6, 10, 12, 18 and 19 have been rejected under 35 U.S.C. 103(a) as being obvious over Hayasaka in view of Roberts and in further view of U.S. Patent No. 5,660,682 to Zhao et al ("the Zhao patent").

In response, it is respectfully submitted that the above rejections have been traversed for at least the reasons set forth below.

First of all, it is submitted that there is insufficient motivation provided to one skilled in the art to combine Hayasaka and Roberts in the manner set forth in the instant Office Action because at the very least the Roberts reference teaches away from making this combination as proposed. It is well established under the U.S. Patent laws, when a prior art reference teaches away or leads away from a claimed invention, obviousness may be rebutted. **(See MPEP 2145).**

In particular, Hayasaka has been cited in the instant Office Action as allegedly teaching the treating of a semiconductor substrate by forming and etching films, including SiO_2 film with a plasma of gas including hydrogen and argon. However, Roberts, on the other hand, teaches away from using hydrogen at all during any stage in a plasma reaction chamber including either etching a semiconductor substrate for producing a semiconductor device or cleaning the inside of a plasma reactor chamber. Roberts teaches away by, for example, discussing what it perceives to be disadvantages associated with using hydrogen during etching semiconductor substrates or cleaning a plasma reactor chamber. **(See Col. 4, lines 55-65 of Roberts).** Moreover, none of the

embodiments described in Roberts utilize hydrogen as an etching chemical. Instead, Roberts teaches using only trifluoroacetic acid and its various derivatives as an etching chemical which may be introduced into a plasma reactor chamber as a vapor or an entrained vapor in a carrier gas for both etching a semiconductor substrate for producing a semiconductor device and cleaning the inside of a plasma reactor chamber.

Consequently, since Hayasaka has been cited herein as teaching an etching process performed on a semiconductor substrate in a reaction chamber using a plasma of gas which includes hydrogen, one skilled in the art would be led away from using the cleaning methods of Roberts, which as discussed above teaches away from cleaning process chambers having hydrogen therein, to clean the reaction chamber of Hayasaka. Thus, there is insufficient motivation provided to one skilled in the art to make the proposed combination.

Furthermore, even, assuming for the sake of argument that there were motivation to combine Hayasaka with Roberts, this combination would still fail to teach or suggest all of the elements recited in claims 1, 7 and 15.

In particular, the combination of Hayasaka and Roberts would at the very least fail to teach or suggest a method which included "...etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.", as essentially recited in claims 1, 7 and 15.

As conceded by the Examiner, Hayasaka is completely silent regarding the details of cleaning the inside surfaces of its processing apparatus. Thus, as a result, Hayasaka is also completely silent with regard to a method which includes removing hydrogen from a processing chamber as required by claims 1, 7, and 15. Moreover, as discussed, Roberts describes not introducing hydrogen at all into the reaction chamber at any stage of semiconductor processing including etching and cleaning stages. Therefore, since in Roberts, hydrogen is not introduced at all into the processing chamber, Roberts thus also consequently fails to teach or suggest a method which includes removing hydrogen from a processing chamber as required by claims 1, 7, and 15.

Accordingly, as can be gleaned from the above, even if Hayasaka and Roberts were combined, this combination would at the very least fail to teach or suggest a method which included "...etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.", as essentially recited in claims 1, 7 and 15.

Therefore, withdrawal of the above rejection to claims 1, 7 and 15 is respectfully requested. As claims 2, 3 and 4 depend from and incorporate all of the limitations of claim 1, claims 8, 9, 11, 13 and 14 depend from and incorporate all of the limitations of claim 7 and claims 16 and 17 depend from and incorporate all of the limitations of claim 15, withdrawal of the rejection to these dependent claims is likewise requested.

Next with regard to the rejections of claims 5, 6, 10, 12, 18 and 19 under 35 U.S.C. 103(a) as being unpatentable over Hayasaka in view of Roberts and in further view of Zhao, it is asserted that these rejections should be withdrawn for at least the reasons discussed above with regard to claims 1, 7 and 15. Specifically, as discussed there is insufficient motivation provided to one skilled in the art for combining Hayasaka and Roberts. Thus, the combination of Hayasaka, Roberts and Zhao as proposed in the instant Office Action is likewise defective and should be withdrawn.

Furthermore, even assuming for the sake of argument that there were motivation to combine Hayasaka with Roberts, this combination would still fail to teach or suggest all of the elements recited in claims 1, 7 and 15.

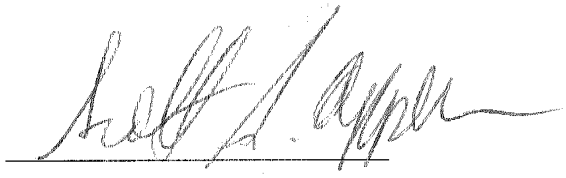
In particular, the combination of Hayasaka and Roberts and Zhao would fail to teach or suggest all of the features of claims 5, 6, 10, 12, 18 and 19 because like Hayasaka and Roberts, Zhao also at the very least fails to teach or suggest a method which includes "...etching the processing chamber with a plasma of a non-hydrogenous second gas to remove hydrogen from the processing chamber.", as essentially recited in claims 5, 6, 10, 12, 18 and 19 .

Therefore, for at least the reasons set forth above, withdrawal of the above rejection to claims 5, 6, 10, 12, 18 and 19 is requested.

VI. CONCLUSION:

For the foregoing reasons, the present application, including claims 1-19, is believed to be in condition for allowance. The Examiner's early and favorable action is respectfully requested. The Examiner is invited to contact the undersigned if he has any questions or comments in this matter.

Respectfully submitted,



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